



Subject card

Subject name and code	, PG_00072209						
Field of study	Mechanical and Medical Engineering						
Date of commencement of studies	October 2024		Academic year of realisation of subject		2026/2027		
Education level	first-cycle studies		Subject group				
Mode of study	Full-time studies		Mode of delivery		at the university		
Year of study	3		Language of instruction		Polish		
Semester of study	5		ECTS credits		2.0		
Learning profile	general academic profile		Assessment form		assessment		
Conducting unit	Institute of Manufacturing and Materials Technology -> Faculty of Mechanical Engineering and Ship Technology -> Faculties of Gdańsk University of Technology						
Name and surname of lecturer (lecturers)	Subject supervisor		dr inż. Łukasz Pawłowski				
	Teachers		dr inż. Beata Majkowska-Marzec				
Lesson types	Lesson type	Lecture	Tutorial	Laboratory	Project	Seminar	SUM
	Number of study hours	15.0	0.0	15.0	0.0	0.0	30
	E-learning hours included: 0.0						
Learning activity and number of study hours	Learning activity	Participation in didactic classes included in study plan		Participation in consultation hours		Self-study	SUM
	Number of study hours	30		1.0		19.0	50
Subject objectives	The aim of the course is to familiarize students with the technologies used for the manufacturing and processing of metallic biomaterials and implants for orthopedic applications, taking into account the influence of individual stages of the technological process on their structure, mechanical and surface properties, and functional performance. Students learn the basic technologies of shaping, heat treatment, finishing, and surface modification, as well as methods for quality control and evaluation of the properties of manufactured biomateria						

Learning outcomes	Course outcome	Subject outcome	Method of verification
	[K6_W05] has knowledge in the areas of design, manufacturing, and operation of materials, machine parts, or technical devices, with a solid understanding of design principles and technical documentation preparation	The student has knowledge of the design, manufacturing, and modification of biomaterials and implants used in orthopedics, understands the basic technologies of their shaping, processing, and surface modification, and knows the principles of selecting materials and technologies according to functional requirements.	[SW3] Assessment of knowledge contained in written work and projects [SW1] Assessment of factual knowledge
	[K6_U06] can identify and formulate specifications for simple practical engineering tasks, and critically analyze existing technical solutions, evaluating their functionality, particularly in the context of designing mechanical and medical-mechanical devices	The student is able to identify and formulate specifications for simple engineering tasks concerning the selection of materials, manufacturing technologies, or surface modification methods for biomaterials and implants, and to critically analyze and evaluate existing technological solutions with regard to the required functional properties.	[SU4] Assessment of ability to use methods and tools [SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information
	[K6_U03] is able to use information and communication skills or research techniques to solve typical engineering tasks related to design, production and manufacturing of materials or machine components	The student is able to use appropriate research techniques and information and communication tools in the design, manufacturing, surface modification, and evaluation of the properties of biomaterials and implants used in orthopedics.	[SU3] Assessment of ability to use knowledge gained from the subject [SU2] Assessment of ability to analyse information
	[K6_U04] is able to utilize empirical, analytical, simulation, and computer-based methods to formulate and solve engineering tasks in the field of medical and mechanical engineering	The student is able to select and apply empirical and analytical methods, as well as computer-based tools, for the design, manufacturing, and evaluation of the properties of biomaterials and implants, taking into account their structure, mechanical, surface, and corrosion properties.	[SU2] Assessment of ability to analyse information [SU4] Assessment of ability to use methods and tools
Subject contents	Course content – lecture Course Content Characteristics of metallic biomaterials used in orthopedics. Manufacturing and preparation of metal alloys for implant applications. Casting technologies, including precision and vacuum casting. Plastic deformation processing and powder metallurgy. Machining, finishing, and heat treatment of metallic biomaterials. Technologies for surface modification of implants. The influence of manufacturing technologies on microstructure, mechanical properties, surface topography, and corrosion resistance. Quality control of biomaterials and orthopedic implants, including basic methods of mechanical, corrosion, and surface testing. Examples of technological processes for manufacturing selected orthopedic implants.		
	Course content – laboratory • Preparation of a titanium substrate for coating deposition • Fabrication of carbon coatings on a titanium substrate • Design of biofunctional hydrogels for specific biomedical applications • Production of bacterial nanocellulose by fermentation using a SCOBY culture • Fabrication of composite coatings based on natural polymers using the EPD technique		
Prerequisites and co-requisites	Knowledge of materials science and biomaterials.		
Assessment methods and criteria	Subject passing criteria	Passing threshold	Percentage of the final grade
	Written examination	56.0%	50.0%
	Laboratory exercises	56.0%	50.0%

Recommended reading	Basic literature	B. Świczko-Żurek, A. Zieliński, A. Ossowska, S. Sobieszczyk: Biomateriały. Wyd. Politechniki Gdańskiej, Gdańsk, 2011. A. Zieliński, W. Serbiński, T. Seramak, A. Ossowska, B. Świczko-Żurek: Innowacyjne technologie kształtowania właściwości materiałów konstrukcyjnych i biomedycznych. Wyd. Politechniki Gdańskiej, Gdańsk, 2018. J. Marciniak, M. Błażewicz, W. Torbicz: Biomateriały. [W] Inżynieria biomedyczna. Podstawy i zastosowania. Tom 4. Akad. Ofic. Wydawn. Exit, Katowice, 2016.
	Supplementary literature	M. Bartmański, A. Hernik, M. Jażdżewska, B. Majkowska-Marzec, A. Ossowska, B. Świczko-Żurek, B. Trybuś, J. Wosek, K. Zasińska, A. Zieliński: Nanotechnologia w medycynie i kosmetologii. Wyd. Politechniki Gdańskiej, Gdańsk, 2018. H. Singh, S. Singh, C. Prakash: Current Trends in Biomaterials and Bio-manufacturing. [W] Biomanufacturing, Chapter 1, pp. 1-39. https://www.researchgate.net/publication/331161230_Current_Trends_in_Biomaterials_and_Bio-manufacturing.
	eResources addresses	
Example issues/ example questions/ tasks being completed	1. What material properties determine the suitability of metallic materials for orthopedic implant applications? Give examples of materials used for implants. 2. How does the manufacturing and processing technology affect the microstructure, mechanical properties, surface topography, and corrosion resistance of an implant? 3. What methods can be used to assess the quality and surface properties of metallic orthopedic implants, and what information can be obtained using these methods?	
Practical activities within the subject	Not applicable	

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